

# An Integrated Noncommunicable Disease Risk Assessment and Data Management Application for Community Health Promotion Campaigns

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## Abstract

The aim of this study is to present a software application that facilitates consistent data collection, questionnaire administration, noncommunicable disease risk scoring for the benefit of the participants to community health promotion campaigns. The application was developed using open source scripting language, database management system and server. The application calculates the risk scores based on demographic data (sex, age), anthropometric measurements (height, weight), blood pressure, blood tests (blood glucose, total cholesterol, HDL cholesterol, and triglycerides) and on a brief lifestyle questionnaire. A summary of data and risk scores grouped at individual level can be printed as a handout for personal use or lifestyle counseling. Also, the application can aggregate the data at group level after basic statistical analysis and display them as tables and charts. Finally, the database can be exported for advanced statistical analysis for research purposes.

**Keywords:** Computer Software Applications; Risk Assessment; Health Promotion.

## Introduction

The prospects of reduced costs, improved quality and enhanced productivity has driven the implementation of information and communication technology (ICT) in healthcare for more than 20 years but until a few years ago, experts observed a relatively limited adoption of ICT in medicine compared to other industrial fields [1,2]. During the first decade of the emerging health information technology (HIT) the initiatives were oriented primarily towards the healthcare providers [3]. HIT covered a large array of applications such as electronic medical records, clinical decision support, computerized physician order entry, automation in clinical laboratory, radiology, and critical care, computerized data banks, administration of medical supplies, health system management etc. [1]. The rise and expansion of new interdisciplinary fields such as consumer health informatics, reflects a strong concern in addressing directly the needs of consumers and patients through computers and

communications systems with the aim of empowering them as responsible health information seekers and decision makers.[3] This trend is supported by the recently renewed European Digital Agenda that defines as one of its strategic priorities the “ICT for Health activities” which are to address the "health management continuum from lifestyle to disease management, including disease prevention and management of comorbidities" [4].

Although various risk calculators are in use for many noncommunicable, preventable diseases (coronary heart disease, stroke, hypertension, obesity, diabetes mellitus type II), nutrition and lifestyle assessment tools (calorie counters, weight control monitoring tools, nutritional analysis tools, physical activity monitoring tools, tobacco smoking cessation tools, alcohol abuse assessment tools, stress appraisal and coping tools etc.), implementation of information technology in community health promotion campaigns in Romania, seems to lag behind. It is expected that community health promotion events would benefit if such tools would be available and implemented by improving data collection, standardizing measurement procedures, communication with and counseling of the participants/consumers.

The aim of this study is to present ExpoData 2.0, a software application that facilitates consistent data collection, lifestyle questionnaire administration and noncommunicable disease risk assessment for the benefit of the participants to community health education campaigns.

## Material and Method

### *Scripting Language, Database System and Webserver*

The application was developed with the aim of organizing, generating statistics and reports of participants' data and also of saving the data for later use. To meet these requirements we needed more than one input terminal to insert and process the data and an Operating System independent application.

The web application was developed using PHP as scripting language and MySQL as database management system. There are a number of web-servers that support PHP scripting language, such as Apache web server. We embedded in the installation process of ExpoData version 2.2.14 of the Apache. The Graphical User Interface (GUI) was built using CSS/HTML and Yahoo User Interface (YUI) Library. YUI is an open source JavaScript library, used for building richly interactive web applications using techniques such as AJAX, DHTML and DOM, and is available under BSD License.

The bridge between GUI and the database was achieved by using PHP (5.2.6) scripting language which performs all queries to the database synchronously and asynchronously. PHP is free software too, released under the PHP license.

All participants' data are stored in a MySQL (5.0.51a) database consisting of 11 tables. The selection of MySQL database as data storage for our application was a natural process because of its fast response, relational database and because it is well known as a central component of widely used LAMP and AMP (Linux, Apache, MySQL, PHP) web applications [5].

The application runs inside the browser window and its functionality was tested in Mozilla Firefox 25.0.1, Chrome 29.0.1547.66 and Internet Explorer 10.0.11). ExpoData 2.0 is available in Romanian and English language.

### *Health Score and Cardiovascular Risk Assessment Tool*

The Health Score was developed based mainly on the Alameda County Study, a classic lifestyle and longevity prospective cohort research conducted by Nedra B. Belloc from the California State Department of Public Health [6]. The contributions of the health practices to the health score were adjusted according to some subsequently published studies relevant to the topic [7-9]. A psychological variable (optimistic vs pessimistic outlook) was added based on the works of several other authors [10-13].

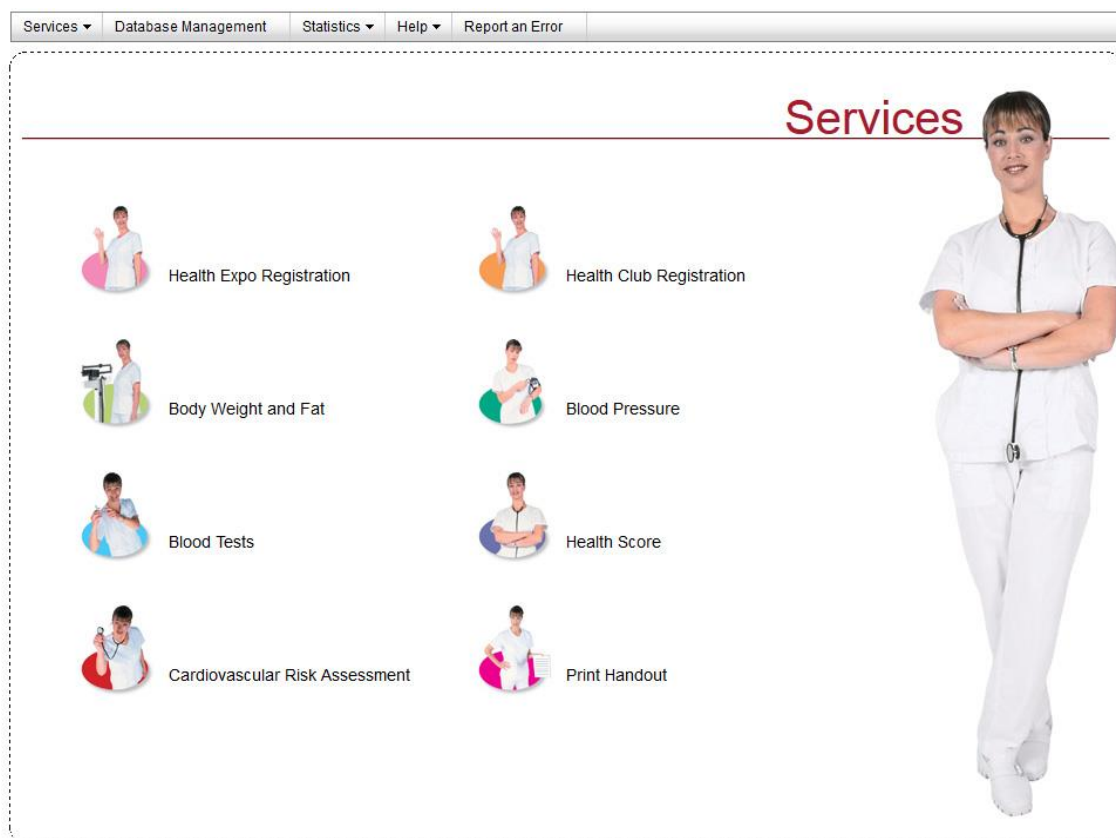
The cardiovascular risk score was developed using the Framingham Study calculus algorithm for 10 year prediction of general cardiovascular disease as published in several papers by the principal

investigators involved in the research [14-16].

## Results

The Graphical User Interface was designed on the WIMP paradigm ("window, icon, menu, pointing device"). A pull-down type menu bar is displayed across the top of the start-up and all the subsequent screens.

The primary sections of the application are accessible from the first Services menu and also, directly from the icons displayed on the home screen (Figure 1).



**Figure 1.** The Home-page of ExpoData 2.0

The primary sections of the application correspond to the screening and preventive counseling services offered to the participants: the registration booth/page, the body weight and body fat percentage booth/page, the blood pressure booth/page, the blood chemistry booth/page, the health score booth/page, the cardiovascular risk assessment booth/page and the print handout page/counseling booth.

On the registration page the operators fill in the patients' demographic data (age, sex, residency, education, ethnicity etc.). The application automatically allocates a unique registration number to each participant thus ensuring that all the data belonging to a particular participant are consistently grouped together as participants move from one Health Expo booth to the other.

On the body weight page are recorded the height, weight, percentage of body fat and the waist circumference of the participants. The application calculates the body mass index (BMI) of the participant based on his/her height and weight and attaches it to the participants profile in the database (Figure 2).

Participant No.:	905	
Body weight:	<input type="text"/>	lbs
Height:	<input type="text"/>	feet <input type="text"/> inches
Percent body fat:	<input type="text"/>	% (ie. 30.0)
Waist Circumference:	<input type="text"/>	inches (e.g. 35)

Figure 2. Body weight page

On the blood pressure page, besides the actual systolic and diastolic values of the blood pressure measured at the event by nurses or trained volunteers, are recorded the latest previously measured blood pressure values along with the time, person / place where these values were measured (hospital, family practice, home). Also, the operator records if the participant has been diagnosed with hypertension by a medical professional and whether he/she is taking regularly medication for high blood pressure (Figure 3).

Participant No.: 905	
Have you been diagnosed with high blood pressure?:	<input type="radio"/> Yes <input checked="" type="radio"/> No
Do you take medication for your high blood pressure?:	<input type="radio"/> Yes <input checked="" type="radio"/> No
When did you last have your blood pressure checked?:	<input checked="" type="radio"/> During the last week <input type="radio"/> During the last month <input type="radio"/> During the last year <input type="radio"/> More than a year before <input type="radio"/> Not checked / Don't remember when
Who checked it and where? (Only if applicable):	<input checked="" type="radio"/> At home - Myself <input type="radio"/> At home - Family member or neighbour <input type="radio"/> At home - Nurse <input type="radio"/> At a clinic or hospital - Nurse or physician <input type="radio"/> Not applicable
What was your blood pressure measurement then? (Only if applicable):	Systolic BP <input type="text"/> mmHg (e.g. 120) Diastolic BP <input type="text"/> mmHg (e.g. 80)
Blood pressure numbers measured at the Health Expo:	Systolic BP <input type="text"/> mmHg (e.g. 120) Diastolic BP <input type="text"/> mmHg (e.g. 80)

Figure 3. Blood pressure page

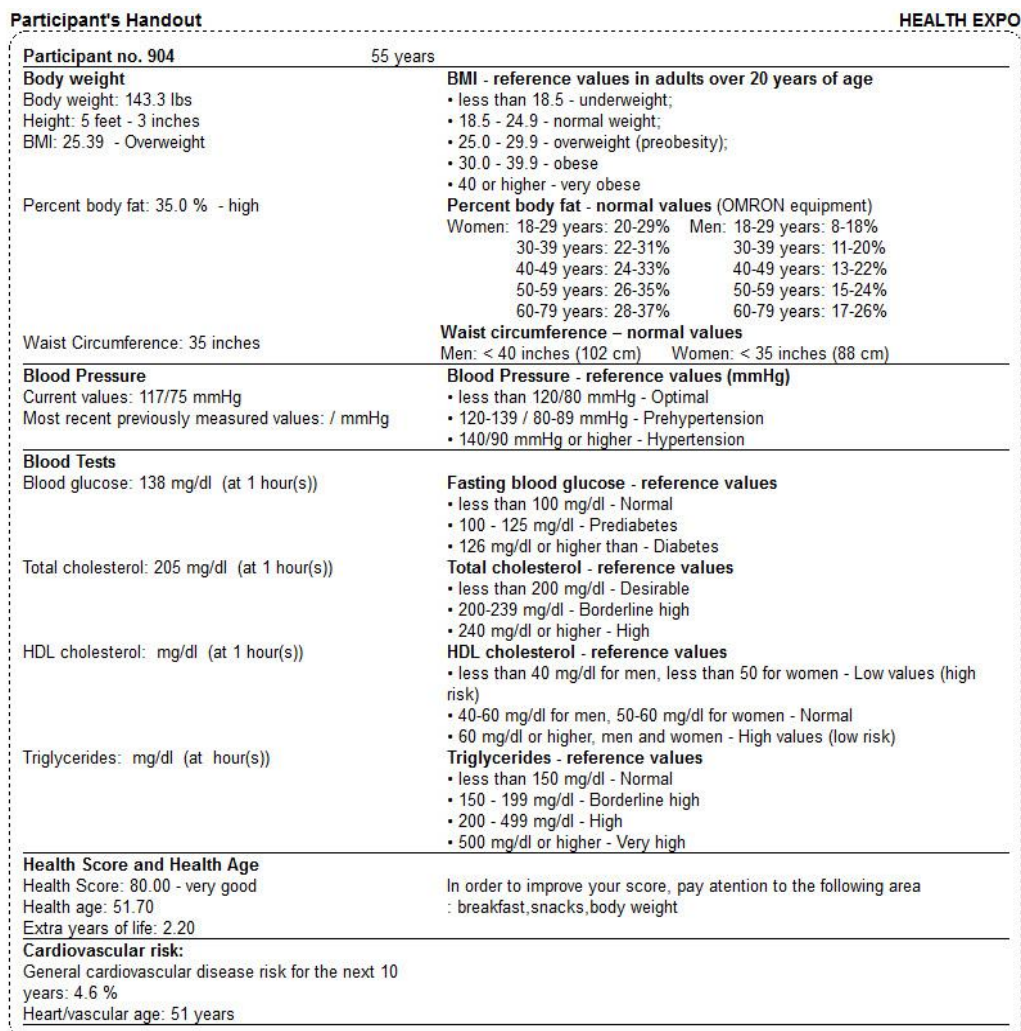
The blood tests page displays blank text fields for blood glucose levels, total cholesterol, HDL cholesterol levels and triglycerides level. In order to prevent gross inaccuracies in interpretation of the values, the operator records also the hours passed since the participant served his/her last meal or snack. Also, there is a check box to identify the participants who have been previously diagnosed with diabetes mellitus.

The health score page consists of a questionnaire with close ended questions with pre-selected options that collects data regarding the basic behavioral and psychological factors correlated to longevity (breakfast, snacking, physical activity, alcohol consumption, active smoking, exposure to environmental tobacco smoke, sleep habits, body mass index, and optimism).

The next section, the cardiovascular risk assessment page, has two different versions. Both of them include a set of common risk factors (age, sex, being under antihypertensive medication, being diagnosed with diabetes mellitus, current smoker, high systolic blood pressure values) and some specific factors: BMI for one of the versions and total cholesterol and HDL cholesterol for

the other.

At the last health booth, the participant receives his/her printed handout that summarizes the results of the measurements and the risk scores derived from them in the left column, and the normal values and short explanations that help the participants to understand their risk and the lifestyle changes that could possibly improve their risk level, on the right column (Figure 4).



**Figure 4.** Participant's handout with measurement and risk score results and reference values

The Database management page can be accessed from the second tab of the main menu. The administrator can create new databases, check which is the active database, export, import, load or delete any of the databases as needed. The databases can be exported in sql and csv format. The second one can be easily imported into any spreadsheet application for further data analysis.

The next tab on the main menu opens the statistics pages. The operators and the administrator can see at any given moment, the aggregate data about the number of participants, attendance by sex, age, residency, the results of the anthropometric and biochemistry measurements as well as the graphs showing the health scores and the cardiovascular risk score by categories (Figure 5).

The Help pages can be accessed from the main menu and they include brief instructions about installation/uninstallation, entering, editing, deleting data, printing the handout, displaying the statistics and also a guidance page for the database management.

The last tab of the menu opens the page where the operators can send their suggestions to the manager of the campaign, and also can report any application errors to the system admin.

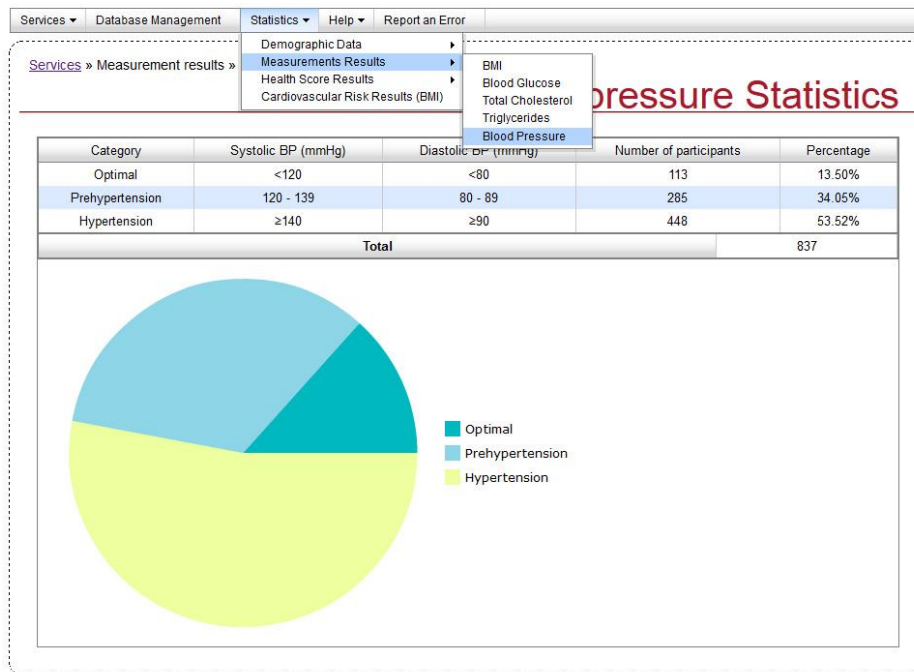


Figure 5. The statistics submenu and the blood pressure statistics page

## Discussion

Since 1986, when the Ottawa Charter for Health Promotion has been issued, the Non-Governmental Organizations (NGOs) became an important part of the Community Health Promotion efforts [17]. While many such organizations are involved in various health promotion programs, the methodology of the interventions is poorly described and there are virtually no data regarding the impact of Romanian NGO's on the knowledge, attitudes and health behaviors of the targeted groups. It has been noticed that even in more developed countries, most often the organizers lack the know-how and the financial resources needed for rigorous outcome evaluation [18]. Program evaluation is often limited to the basic elements of process evaluation (number of participants, amount of health materials distributed etc.).

By facilitating a systematic and valid data collection, also the monitoring of the participants flow during the event and the final evaluation of the campaign, the application has a real potential to help the organizers in improving the efficiency of the campaign. By making available to the participants the results of the measurements and risk assessments in a well-structured and visually pleasing document, ExpoData is likely to increase the participants' satisfaction and indirectly the desirability of the campaign. Recording the data in an electronic format compatible with common statistical analysis applications, opens valuable opportunities for scientific research, enabling the generation and testing of hypotheses in the field of community health promotion. So far, the analysis of data gathered at a two campaigns held in a Transylvanian urban area, contributed to a better understanding of the demographic profile of the participants and thus laid the ground for adapting the content of the campaign to the characteristics of the participants [19].

The health score and the cardiovascular risk assessment tool have not been validated on the Romanian population since such a task would take a considerable investment in running a prospective cohort study. However, given the global character of the major public health problems a fair degree of validity can reasonably be postulated. The positive impact of the application as a health education tool on the knowledge, attitudes and health behavior of the participants might be observed independently of its accuracy simply by promoting proven health enhancing habits such as good diet, regular physical activity, rest, tobacco smoke free lifestyle, avoidance of alcohol abuse etc.

As far as the content of the application, the next version of ExpoData will include a new module addressing the assessment of diabetes mellitus type 2 risks and as far as technical improvements, a web-based version is envisioned.

## **Conclusions**

ExpoData is a software application developed for an integrated management of the medical and demographic data of participants' data. The application helps the organizer in estimating the necessary equipment, supplies and human resources, streamlines and monitors the flow of participants at the booths, guarantees a systematic and valid data collection and enhances the final assessment and statistical analysis of the participants' data.

With ExpoData the participants' data are accurately and efficiently collected and processed, and then incorporated in a unique document which can be readily handed out to each participant.

The database compiled by the application offers opportunities for scientific research, and also the possibility of generating and testing hypotheses in the public health domain.

## **List of abbreviations**

BMI - Body Mass Index  
GUI - Graphical User Interface  
HIT - Health Information Technology  
ICT - Information and Communication Technology  
LAMP - Linux, Apache, MySQL, PHP  
WIMP - Window, icon, menu, pointing device  
YUI - Yahoo User Interface

## **Conflict of Interest**

The authors declare that they have no conflict of interest.

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